~~SECRET~~

PROJECT CHECO SOUTHEAST ASIA REPORT

"INK"
DEVELOPMENT AND EMPLOYMENT

(THIS COVER IS UNCLASSIFIED)

~~SECRET~~

PROJECT
Contemporary
Historical
Examination of
Current
Operations
REPORT

"INK"
DEVELOPMENT AND EMPLOYMENT

24 SEP 73

HQ PACAF
Directorate of Operations Analysis
CHECO/CORONA HARVEST DIVISION

Prepared by:
Major B.H. Barnette Jr.
Project CHECO 7th AF

~~SECRET~~

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
Department of the Air Force Headquarters Pacific Air Forces, CHECO Division Hickam AFB, HI	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT

A -- Approved for Public Release

13. SUPPLEMENTARY NOTES

14. ABSTRACT

Project CHECO was established in 1962 to document and analyze air operations in Southeast Asia. Over the years the meaning of the acronym changed several times to reflect the escalation of operations: Current Historical Evaluation of Counterinsurgency Operations, Contemporary Historical Evaluation of Combat Operations and Contemporary Historical Examination of Current Operations. Project CHECO and other U. S. Air Force Historical study programs provided the Air Force with timely and lasting corporate insights into operational, conceptual and doctrinal lessons from the war in SEA.

15. SUBJECT TERMS

CHECO reports, Vietnam War, War in Southeast Asia, Vietnam War- Aerial Operations, American

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. TELEPHONE NUMBER *(Include area code)*

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS PACIFIC AIR FORCES
APO SAN FRANCISCO 96553

PROJECT CHECO REPORTS

The counterinsurgency and unconventional warfare environment of Southeast Asia has resulted in USAF airpower being employed to meet a multitude of requirements. These varied applications have involved the full spectrum of USAF aerospace vehicles, support equipment, and manpower. As a result, operational data and experiences have accumulated which should be collected, documented, and analyzed for current and future impact upon USAF policies, concepts, and doctrine.

Fortunately, the value of collecting and documenting our SEA experiences was recognized at an early date. In 1962, Hq USAF directed CINCPACAF to establish an activity which would provide timely and analytical studies of USAF combat operations in SEA and would be primarily responsive to Air Staff requirements and direction.

Project CHECO, an acronym for Contemporary Historical Examination of Current Operations, was established to meet the Air Staff directive. Based on the policy guidance of the Office of Air Force History and managed by Hq PACAF, with elements in Southeast Asia, Project CHECO provides a scholarly "on-going" historical examination, documentation, and reporting on USAF policies, concepts, and doctrine in PACOM. This CHECO report is part of the overall documentation and examination which is being accomplished. It is an authentic source for an assessment of the effectiveness of USAF airpower in PACOM when used in proper context. The reader must view the study in relation to the events and circumstances at the time of its preparation--recognizing that it was prepared on a contemporary basis which restricted perspective and that the author's research was limited to records available within his local headquarters area.

Robert E Hiller

ROBERT E. HILLER
Director of Operations Analysis
DCS/Operations

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS PACIFIC AIR FORCES
APO SAN FRANCISCO 96553

REPLY TO ATTN OF: DOAD

24 September 1973

SUBJECT: Project CHECO Report, "'INK' Development and Employment"

TO: SEE DISTRIBUTION PAGE

1. Attached is a SECRET document. It shall be transported, stored, safeguarded, and accounted for in accordance with applicable security directives. Retain or destroy in accordance with AFR 205-1. Do not return.

2. This letter does not contain classified information and may be declassified if attachment is removed from it.

FOR THE COMMANDER IN CHIEF

V. H. Gallacher

V. H. GALLACHER, Lt Colonel, USAF
Chief, CHECO/CORONA HARVEST Division
Directorate of Operations Analysis
DCS/Operations

1 Attachment
Project CHECO Report (S),
24 September 1973

DISTRIBUTION LIST

1. SECRETARY OF THE AIR FORCE
   - a. SAFAA 1
   - b. SAFLL 1
   - c. SAFOI 2
   - d. SAFUS 1

2. HEADQUARTERS USAF
   - a. AFNB 1
   - b. AFCCS
     - (1) AFCCN 1
     - (2) AFCVC 1
     - (3) AFCHOS 2
   - c. AFCSA
     - (1) AF/SAG 1
     - (2) AF/SAMI 1
   - d. AFIGO
     - (1) AFOSI/IVOA 3
     - (2) IGS 1
   - e. AFIS/INTC 5
   - f. AFODC
     - (1) AFPRC 1
     - (2) AFPRE 1
     - (3) AFPRM 1
   - g. AFPDC
     - (1) AFDPW 1
   - h. AFRD
     - (1) AFRDP 1
     - (2) AFRDQ 1
     - (3) AFRDQPC 1
     - (4) AFRDR 1
     - (5) AFRDQL 1
   - i. AFSDC
     - (1) AFLGX 1
     - (2) AFLGF 1
     - (3) AFLGT 1
     - (4) AFLGY 1
   - j. AFXO 1
     - (1) AFXOD 1
     - (2) AFXODC 1
     - (3) AFXODD 1
     - (4) AFXODL 1
     - (5) AFXOOG 1
     - (6) AFXOSL 1
     - (7) AFXOOSN 1
     - (8) AFXOOSO 1
     - (9) AFXOOSS 1
     - (10) AFXOOSV 1
     - (11) AFXOOSR 1
     - (12) AFXOOSW 1
     - (13) AFXOOSZ 1
     - (14) AFXOXAA 6
     - (15) AFXOXXG 1

3. MAJOR COMMAND
   - a. TAC
     - (1) HEADQUARTERS
       - (a) XPSY 1
       - (b) DOC 1
       - (c) DREA 1
       - (d) IN 1
     - (2) AIR FORCES
       - (a) 12AI
         - 1. DOO 1
         - 2. IN 1
       - (b) T9AF(IN) . . . 1
       - (c) USAFSOF(DO) . 1

(3) WINGS
- (a) 1SOW(DOI) . . 1
- (b) 23TFW(DOI) . . 1
- (c) 27TRW(DOI) . . 1
- (d) 33TFW(DOI) . . 1
- (e) 35TFW(DOI) . . 1
- (f) 366TFW(DOI) . 1
- (g) 67TRW(DOI) . . 1
- (h) 316TAW(DOX) . 1
- (i) 317TAW(DOI) . 1
- (j) 474TFW(DOI) . 1
- (k) 463TAW(DOX) . 1
- (l) 58TAC FTR TNG WG 1
- (m) 354TFW(DOI) . 1
- (n) 314TAW(DOI) . 1

(4) TAC CENTERS, SCHOOLS
- (a) USAFTAWC(IN) . 1
- (b) USAFTFWC(DR) . 1
- (c) USAFAGOS(EDA) 1

b. SAC
(1) HEADQUARTERS
- (a) XPX 1
- (b) LG 1
- (c) IN 1
- (d) NR 1
- (e) HO 1

(2) AIR FORCES
- (a) 2AF(IN) . . . 1
- (b) 8AF(DOA) . . . 2
- (c) 15AF(INCE) . . 1

c. MAC
(1) HEADQUARTERS
- (a) DOI 1
- (b) DOO 1
- (c) CSEH 1
- (d) MACOA 1
- (e) 60MAWG(DOI) . 1

(2) MAC SERVICES
- (a) ARRS(XP) . . . 1

d. ADC
(1) HEADQUARTERS
- (a) DOA 1
- (b) DOT 1
- (c) XPC 1

(2) AIR DIVISIONS
- (a) 25AD(DOI) . . 1
- (b) 20AD(DOI) . . 1

e. ATC
(1) DOSPI 1

f. AFSC
(1) HEADQUARTERS
- (a) XRP 1
- (b) SDA 1
- (c) HO 1
- (d) ASD(RWST) . . 1
- (e) RADC(DOT) . . 1
- (f) ADTC(CCN) . . 1
- (g) ADTC(DLOSL) . 1
- (h) ESD(YWA) . . . 1
- (i) AFATL(DL) . . 1
- (j) ESD(XRP) . . . 1

g. USAFSS
(1) HEADQUARTERS
- (a) AFSCC(SUR) . . 2

h. USAFSOS
(1) HEADQUARTERS
- (a) ESD 1

i. PACAF
(1) HEADQUARTERS
- (a) DP 1
- (b) IN 1
- (c) XP 2
- (d) CSH 1
- (e) DC 1
- (f) LG 1
- (g) DOAD 6

(2) AIR FORCES
- (a) 5AF
  - 1. CSH 1
  - 2. XP 1
  - 3. DO 1
- (b) T3AF(CSH) . . 1
- (c) 7AF/OLAA(CHECO) 2

(3) AIR DIVISIONS
- (a) 313AD(DOI) . . 1
- (b) 314AD(XP) . . 1
- (c) 327AD(IN) . . 1

(4) WINGS
- (a) 8TFW(DON) . . 1
- (b) 56SOW(WHD) . . 1
- (c) 388TFW(DO) . . 1
- (d) 405TFW(DOI) . 1
- (e) 432TRW(DOI) . 1
- (f) 1st Test Sq (DA) 1

j. USAFE

(1) HEADQUARTERS
- (a) DOA 1
- (b) DOLO 1
- (c) DOOW 1
- (d) XP 1

(2) AIR FORCES
- (a) 3AF(DO) . . . 1
- (b) 16AF(DO) . . . 1

(3) WINGS
- (a) 50TFW(DOA) . . 1
- (b) 20TFW(DOI) . . 1
- (c) 401TFW(DCOI) . 1
- (d) 513TAW(DOI) . 1

4. SEPARATE OPERATING AGENCIES

a. DMAAC/PR 1

b. AFRES(XP) 2

c. 3825 Acad Svs Gp
- (1) ACSC-DAA 1
- (2) AUL/LSE-69-108 . . 2
- (3) HOA 2

d. ANALYTIC SVS, INC. . . 1

e. AFAG(THAILAND) 1

5. MILITARY DEPARTMENTS, UNIFIED AND SPECIFIED COMMANDS, AND JOINT STAFFS

a.	COMUSJAPAN/J3	1
b.	CINCPAC (J301)	2
c.	CINCPACFLT (Code 332)	1
d.	COMUSKOREA (ATTN: J-3)	1
e.	COMUSMACTHAI/MACTJ3	1
f.	COMUSTDC (J3)	1
g.	USCINCEUR (ECJB)	1
h.	CINCLANT (CL)	1
i.	CHIEF, NAVAL OPERATIONS	1
j.	COMMANDANT, MARINE CORPS (ABQ)	1
k.	CINCONAD (COOP)	1
l.	DEPARTMENT OF THE ARMY (ASM-D)	1
m.	JOINT CHIEFS OF STAFF (J3RR&A)	1
n.	JSTPS	1
o.	SECRETARY OF DEFENSE (OASD/SA)	1
p.	CINCSTRIKE (STS)	1
q.	CINCAL (J2)	1
r.	MAAG-CHINA (MGOT-LA)	1
s.	U.S. DOCUMENTS OFFICE, HQ ALLIED FORCES NORTHERN EUROPE	1

6. SCHOOLS

a.	Senior USAF Representative, National War College	1
b.	Senior USAF Representative, Armed Forces Staff College	1
c.	Senior USAF Rep, Industrial College of the Armed Forces	1
d.	Senior USAF Representative, Naval Amphibious School	1
e.	Senior USAF Rep, U.S. Marine Corps Education Center	1
f.	Senior USAF Representative, U.S. Naval War College	1
g.	Senior USAF Representative, U.S. Army War College	1
h.	Senior USAF Rep, U.S. Army C&G Staff College	1
i.	Senior USAF Representative, U.S. Army Infantry School	1
j.	Senior USAF Rep, USA JFK Cen for Mil Asst	1
k.	Senior USAF Representative, U.S. Army Field Artillery School	1
l.	Senior USAF Representative, U.S. Liaison Office	1
m.	Senior USAF Rep, U.S. Army Armor School, Comd and Staff Dept	1

7. SPECIAL

a.	The RAND Corporation	1

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

EDITOR'S NOTE

The author, Major Benjamin H. Barnette, Jr., is a senior navigator and a Distinguished Graduate of the Air Command and Staff College (ACSC). While attending ACSC, he earned a Master of Science degree in Counseling and Guidance from Troy State University. Prior to attending ACSC, Major Barnette spent several years as a navigator in the Military Airlift Command (MAC) and served in various capacities in the personnel field, including a tour on the DCS/Personnel staff at Hq MAC.

The publication copy of this report was prepared and edited by Miss Carolyn E. Carlson, Hq PACAF/DOAD.

INK In Action

FIGURE 1

CHAPTER I

INTRODUCTION

On 15 August 1971, a Forward Air Controller (FAC) using INK equipment on a mission over the STEEL TIGER area of Laos received eight to 10 indications of interdiction targets. He passed this target on to two other FACs, one of whom "reported seeing nothing but trees but requested ordnance on the strength of [the] INK returns. . . . The total Bomb Damage Assessment (BDA) from subsequent airstrikes against this INK target was: 19 medium secondary explosions, 66 small secondary explosions, one large and five medium sustained fires."[1]

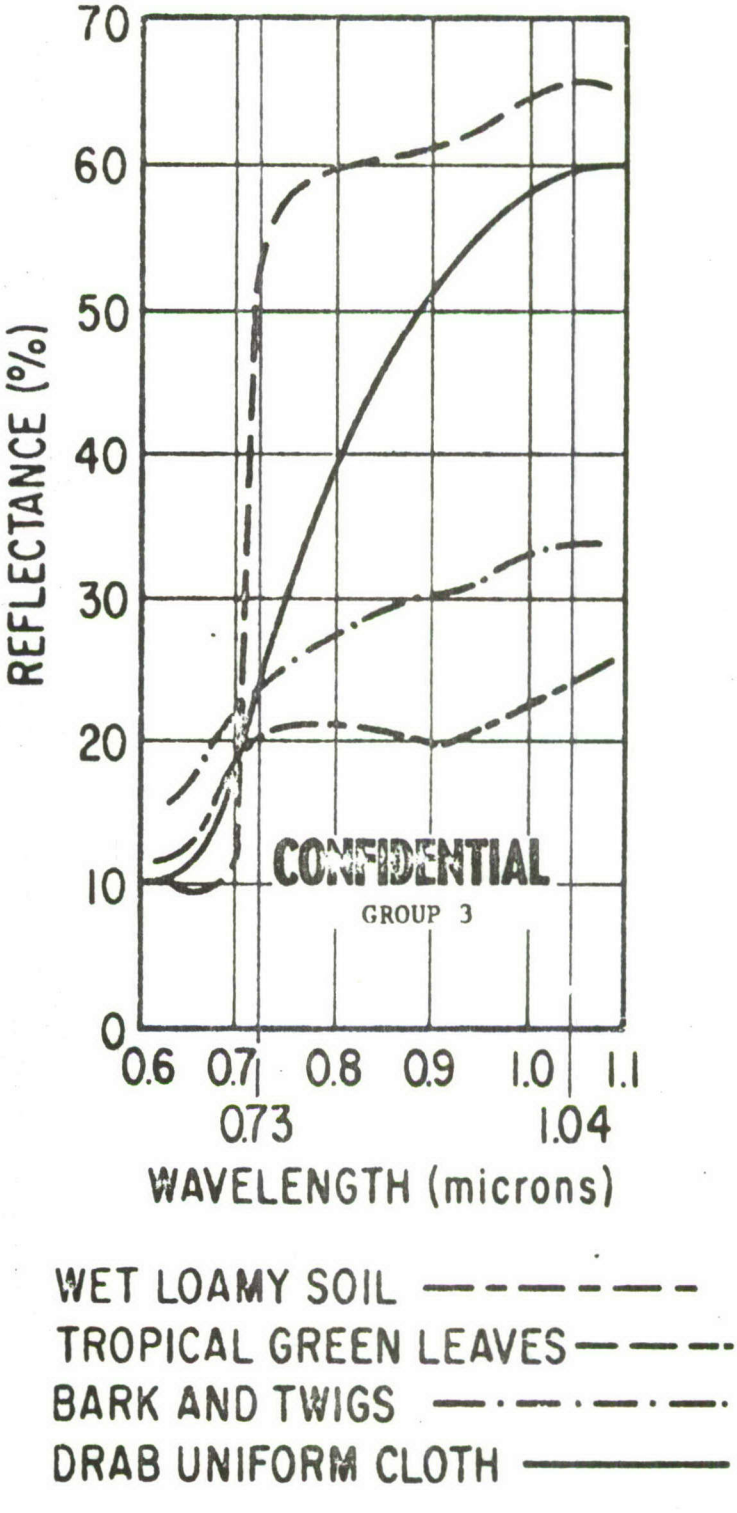
But what was the INK equipment which permitted the operator to see through jungle canopy and spot camouflaged men and equipment where the unaided eye could see "nothing but trees"? How did it begin, what was the course of its development, and what overall conclusions can be drawn with reference to its employment in Southeast Asia (SEA)? The task of this report is to answer these questions.

As the enemy continued to move his war material south toward the Republic of Vietnam (RVN) along the intricate maze of jungle roads and trails known as the Ho Chi Minh Trail, the United States Air Force (USAF) constantly sought new methods of detecting and countering his presence. Although FACs continually scanned the infiltration routes, visual reconnaissance (VR) was severely limited by the double and triple canopy jungle, and small North Vietnamese Army (NVA) and Viet Cong (VC) units were especially difficult to find.[2]

Then in April 1966 the Air Force accepted on contract an unsolicited proposal by Plessett Corporation based on Dr. John Monroe's concept of cloth (man-made camouflage) detection through rotating filters.[3] It promised significant improvements in both VR capability over heavily canopied jungle and in the detection of small enemy contingents. The Air Force designated the initial program HAVE INK, and the first prototype was ready for testing in January 1967. Development of an electro-optical, daytime reconnaissance device giving a real-time camouflage detection capability was well underway.[4]

The technical basis for the detection concept (see Figure 2) was that in the near-infrared (IR) and visual part of the frequency spectrum from approximately 0.72 to 1.2 microns the reflectance of virtually all natural materials increases moderately and quite uniformly as wavelength increases. While there would be bright and dull shades, a scene viewed at those wavelengths would have a monochromatic appearance. Although blending into natural backgrounds to the naked eye, many man-made materials and particularly many camouflaged fabrics had distinctively different reflectances in that frequency spectrum.[5]

When camouflaging mobile objects where complete masking by natural vegetation was not possible, the North Vietnamese employed two fundamental techniques: (1) "the object was made to have an irregular outline, usually by the use of relatively small portions of natural vegetation, while allowing complete freedom of movement," and (2) the object was made to match the contrast of its background. "This meant coloring the object to approximate the visible color of the dominant component of the background." Often,



Reflectance Data For Filter Selection

FIGURE 2

the North Vietnamese used irregular paint patterns to break up the outline and to reduce contrast against a conglomerate background. With the development of camouflage detection (CD) film, "the meaning of contrast matching was extended to include matching both in the visible and near-IR spectral regions." Matching dyes and paints against a chlorophyll background was relatively successful across both regions.[6]

> The inventor of the HAVE INK . . . concept recognized that although camouflage designers could match chlorophyll in the CD film band, no dyes existed that possessed the very rapid increase in reflectance of chlorophyll in the region from 0.70 to 0.75 micron. . . . He correctly asserted that, due to this particular shortcoming of the man-made camouflage dyes, they would be discernible from the natural background when observed alternately through two narrow band-pass filters, one centered at 0.74 micron and the other at about 1.0 micron.[7]

This then became the basis for the design of a monocular (initially) and binocular (subsequently) detector using two rotating filters passing alternately across the field of view. The general tropical background (green leaves, bark, and soil) had a known curve of reflectance versus light wavelength, while the man-made dyes used in uniforms and camouflage cloth had a different curve. By using two wavelengths some distance apart in the spectrum and passing filters screening out all but these two wavelengths alternately across the field of view, the background appeared at a constant intensity, while man-made cloth objects appeared to pulsate.[8] Some of the camouflage paint on vehicles, guns, and other material gave the same effect.[9]

Advantages of this type of detector were threefold: First, form recognition was not required. The FAC no longer had to "mentally pick the form

or shape of the camouflaged object from the surrounding shadows or covering branches." Regardless of how well the lines, edges, color, and form of the object had been made to blend with the surroundings, "any part of the material viewed through the detector" would pulsate. Second, since the detector was "optimized for reflected near-IR light" and since substantially larger quantities of light in these wavelengths were available on the ground under a moderately forested canopy, one could see much more through the INK detector than with the naked eye or binoculars if the canopy were open enough to permit vision to the ground.[10] Third, since "contrast alone" was sufficient for target identification, the surveillance area of the detector was considerably larger than was possible for systems which required form recognition.[11]

This then was the theoretical basis for the INK program. The Air Force sought to translate the theory into equipment suitable for operational employment in SEA during 1971 and 1972.

CHAPTER II

DEVELOPMENT

HAVE INK

As noted in the previous chapter, Air Force development of camouflage detection equipment began in April 1966 under the project title, HAVE INK,[12] and the Air Force Weapons Laboratory (AFWL) completed the first prototype in January 1967.[13] Rome Air Development Center (RADC) personnel in conjunction with the AFWL tested the unit at Eglin AFB, Florida, in October and November 1967 and found that it yielded "twice the detection capability of visual reconnaissance using targets simulating stationary, camouflaged troops. . . . It is important to note that this increased effectiveness was attained by virtually untrained operators using relatively primitive equipment."[14] The test "conclusively demonstrated the existence of a unique target signature for many military uniforms and materiel."[15]

HAVE INK II

As a result of the test, the AFWL began modifications to extend the range of the prototype under the informal designation of HAVE INK II. They "increased the magnification to 8-1/2 power, incorporated an image stabilizer, and took this improved detector to Southeast Asia for a demonstration of its capability."[16] The demonstration under combat conditions, begun in December 1967 and concluded in January 1968, "proved the potential usefulness of the system."[17] Although limitations of the equipment required considerable modification prior to any extended operational employment, in January 1968 the 7th Air Force Commander, General Momyer, requested five improved systems

for use by 7th Air Force personnel in SEA. In July 1968, Hq USAF authorized the required additional development and procurement by the Aeronautical Systems Division (ASD) of Air Force Systems Command (AFSC).[18]

COMBAT INK

The immediate task of this new development, nicknamed COMBAT INK, was to correct the deficiencies discovered during the SEA demonstration.[19] Specifically, "the detection range was to be increased to 4,500 feet. The diameter of the surveillance area was to be increased to 300 feet. The filter balance was to be externally controllable . . . [and] a number of image-tube deficiencies were to be corrected." Basically, these were requirements for increased range and resolution, background balance control, ("trim"), and built-in image stabilization. Further requirements were an effective way to correlate observed returns with visual references, binocular instead of monocular viewing, and a weight reduction of the detector head from the 10.5 pounds of the SEA demonstrator.[20]

By virtue of its role in the initial HAVE INK prototype development, the AFWL undertook the COMBAT INK effort. It received funding approval on 27 July 1968, and contractor effort began on 28 August 1968. AFWL procured a sixth device for the Marine Corps and, at one point, it ordered a seventh set (later cancelled due to cost) so that further exploitation and production engineering could be conducted even during the operational test and evaluation (OT&E).[21]

Although originally scheduled for delivery during February 1969, the first set did not arrive until September 1969. After a short evaluation

USAF returned it to the contractor for "elimination of defects and reconfiguration of controls." The remaining five sets arrived at the USAF Special Operations Force (USAFSOF) at Eglin AFB, Florida, during February 1970 to begin the OT&E phase.[22]

The purpose of this OT&E was "to determine the operational capability of the INK detector to detect camouflaged objects." Specific objectives were to determine the:[23]

a. Accuracy of target detection in relation to terrain and foliage.

b. Most effective altitude for target detection.

c. Concept of employment.

d. Operational and engineering deficiencies.

e. Maintenance and logistical requirements.

f. Personnel resource and training requirement to provide maintenance support.

g. Operator training program required.

h. System reliability.

To insure realistic (tropical) environmental evaluation, USAFSOF conducted the majority of tests in the Panama Canal Zone jungle area near Howard Air Force Base (AFB). However, they accomplished airborne specification testing in the semi-tropical areas around Eglin AFB, Florida.[24]

The INK equipment was flight tested in O-1E, O-2A, and U-10B aircraft (through an open door or window) and taxi tested through-the-canopy on the OV-10A. Since most O-1Es were no longer in the U.S. combat inventory, USAFSOF eliminated them from further consideration. Tests were conducted

in the U-10B since it was readily available in the Canal Zone and required no modification for INK installation. However, since it was not a FAC aircraft, it was not considered further. Testing in the OV-10A was conducted only on the ground since the INK equipment impeded normal ejection seat operation. As costs for an installation which would have been safe in flight were prohibitive, the USAFSOF dropped the OV-10A as a likely prospect.[25] Thus the O-2A emerged as the best aerial platform.

In the Canal Zone, aerial operators tested the INK equipment against the following targets: "North Vietnamese and Viet Cong uniform halves, U.S. fatigue halves and jackets, U.S. general purpose netting, U.S. jeep canvas top, North Vietnamese hammocks, U.S. jeeps and trucks, U.S. artillery pieces (105 millimeter howitzers), and U.S. Army troops in combat uniforms." All were detectable except the paint on U.S. military vehicles and approximately 50 percent of the canvas tops on U.S. vehicles. "In general, if the jungle canopy contained nine-inch holes or larger, targets could be picked out by the INK system. If the jungle canopy was more closed than that, complete concealment of the target resulted." Although some natural targets, such as gravel roads, water puddles, tin roofs, and asphalt and concrete areas, also pulsated, the trained operator had no difficulty in differentiating between the camouflaged and natural ones.[26]

The equipment detected targets best at an altitude of 3,200 feet above ground level (AGL) and at an angle of 45 degrees to the ground, although it was tested at altitudes from 500 feet to 10,000 feet AGL. At altitudes below 3,000 feet AGL, the rapid angular rate of change to the target and greater

turbulence* hindered detection. Operators could resort to altitudes above 3,200 feet if enemy antiaircraft artillery (AAA) forced them upward.[27]

Flown under a wide range of light conditions, the system functioned well from one hour after sunrise until one hour before sunset regardless of cloud cover** as long as line of sight to the target could be maintained. The aircrews conducting the test flew a circular, right-hand orbit around the target usually making more than one orbit and often spending 15 minutes on one area 500 feet in diameter.[28]

All operational and engineering deficiencies discovered during the test were attributed to "engineering deficiencies or manufacturing defects" and consisted mainly of leaking stabilizer subsystems, defective image tubes, and stopping filter motors. Spare parts and technical support were not available for most of the OT&E since Plessett Corporation, which had become a division of EG&G, had ceased operations (and their technical knowledge was lost) upon delivery of the fifth INK system to USAFSOF during February 1970. Therefore, the Air Force had to establish its own maintenance capability and supply support.[29]

USAFSOF personnel developed operator and maintenance training courses, including writing the necessary manuals, and designed and built all required test equipment.[30] Based on their experience with the equipment, USAFSOF stated that a 25 percent failure rate for new operators could be expected

---

*The INK equipment will operate in turbulence up to, but not including, moderate turbulence.

**During the later combat evaluation in SEA (CORONET INK), operators found that three miles visibility or more than 3/8 cloud cover reduced the capability of the system and that 4/8 cloud cover resulted in marginal performance.

due to some individuals not being able to adapt to the "flicker threshold phenomena." The constant flickering could cause some persons to have an epileptic seizure, lose consciousness, or become confused.[31]

Numerous manufacturing defects and engineering deficiencies in the five systems made it difficult to assess system reliability. "Although all five systems were delivered to USAFSOF as operational after being ground tested by AFWL, only one system remained operational after one week of airborne testing." That one system was tested, however, to see if the others merited costly repairs and redesign--the final determination was that they did.[32]

By mid-April 1970, most of the OT&E was complete.[33] In July 1970, USAF approved the additional funding, and three contracts were awarded for the required work and spare parts procurement.[34] For the next five months, none of the units were operational since all were in the repair and redesign phase and in some state of disassembly. However, all of the sets were operationally ready two weeks prior to the completion of the OT&E in January 1971.[35]

In addition, a 90-day parts supply kit had been assembled based on usage rates during the OT&E. It was "not 100 percent spared and items not considered field repairable . . . were omitted."[36]

The final conclusions of the OT&E were:[37]

a. The INK system is capable of detecting a 9-inch diameter of U.S. fatigue cloth or North Vietnamese green uniform cloth material from 4,500 feet slant range. The system can also detect a man-size, uniformed target of the same materials

from 14,000 feet slant range.* This capability exists for line-of-sight conditions with tropical or semi-tropical backgrounds.

b. The INK system should be used in jungle environments in O-2A aircraft operating between 1 hour after sunrise to 1 hour before sunset. Search altitudes should be between 1,000 feet and 10,000 feet AGL, using the most effective altitude of 3,200 feet AGL if weather and enemy defenses permit. The search pattern should be a right-hand orbit about the area to be searched.

c. Within the selected concept of employment, the system has no operational deficiencies. The engineering deficiencies that were identified during the test were corrected prior to test completion.

d. Air Force maintenance of the INK system is feasible.

e. The maintenance technician training course requires 40 classroom hours, and AFSC 301XX is a usable resource for personnel.

f. The operator training program requires 3 classroom hours and approximately 10 flying hours.

g. The reliability of the present system is unknown.

The equipment had progressed in design and development since Plessett Corporation built the initial HAVE INK prototype some four years earlier. In its final configuration and ready for SEA deployment, the system consisted of a detector head, control box, power supply, a battery source for ground use, and three interconnecting cables. (See Figure 3.) Only one battery was provided for the five systems; however, it could be recharged by plugging it into any 110 volt alternating current outlet. Installed in

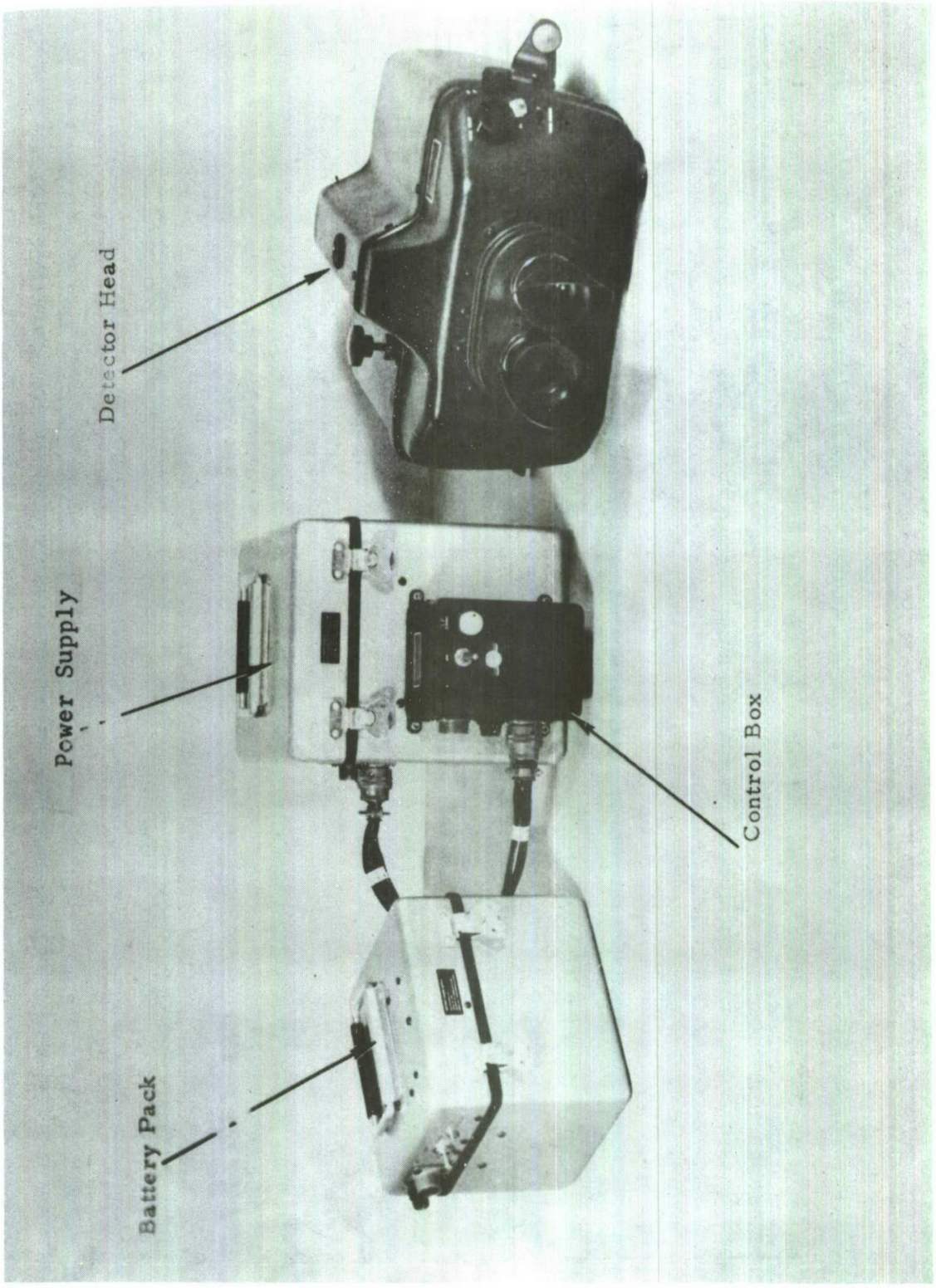
---

*Operating altitude of 10,000 feet AGL.

the aircraft, the equipment weighed 40 pounds, 24 pounds of which was the detector head.[38] The detector head had increased from 10.5 to 24 pounds due to necessary engineering modifications.

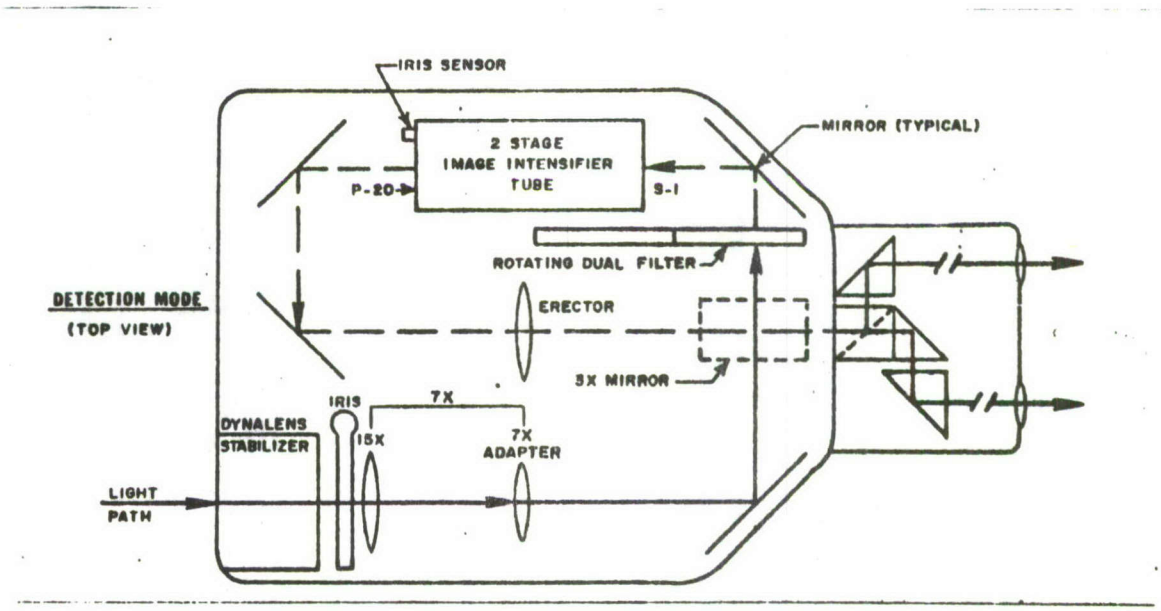
The system gave the operator a "choice of 7- or 15-power viewing through the image intensifier tube and rotating filter" and provided an "image stabilized view of flickering targets." (See Figure 4.) If desired, he could replace the view through the image tube with a "direct unstabilized 3-power view by activating a solenoid-driven mirror." The three-power view allowed the operator to locate the targets seen through the image tube in relation to the surrounding terrain for target marking purposes.[39]

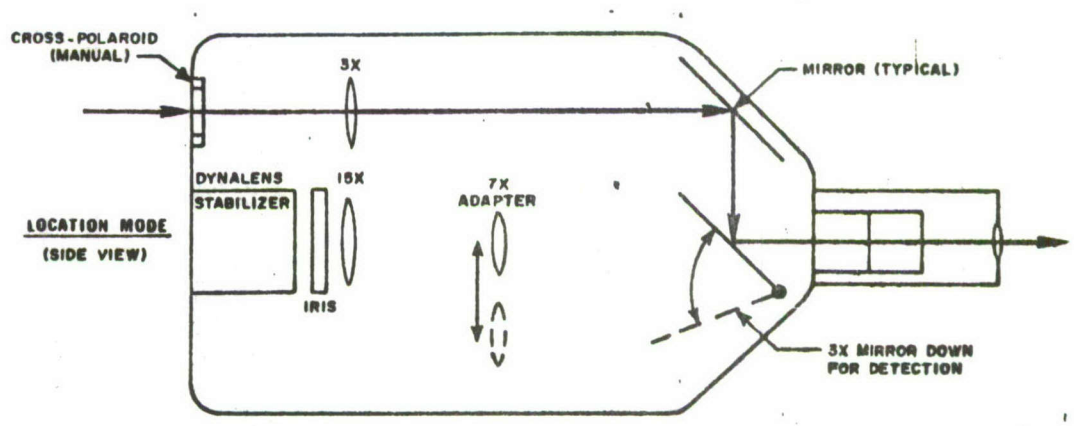
At the conclusion of the COMBAT INK OT&E, USAFSOF recommended that the systems be deployed for combat evaluation.[40]



INK System Components

FIGURE 3





INK Detector Head

(Schematic)

FIGURE 4

CHAPTER III

COMBAT EVALUATION

(CORONET INK)

The Chief of Staff, U.S. Air Force, implemented TAC OPLAN 19 governing the redeployment and SEA evaluation of the INK system (nicknamed CORONET INK) on 26 January 1971.[41] One week later, on 2 February 1971, the introduction team consisting of Major Richard E. Pierson and 1/Lt James N. Hutchinson departed Eglin AFB, Florida, enroute to the 20th Tactical Air Support Squadron (TASS), Da Nang Air Base (AB), RVN.[42] Lt Hutchinson accompanied the five INK systems, O-2A aircraft modification kits, spare parts, test equipment, manuals, and training materials directly to Da Nang AB arriving there 7 February 1971, while Major Pierson stopped enroute to brief Hq PACAF and 7th AF personnel.[43]

The purpose of the test was to[44]

> . . . evaluate the INK system as a camouflage detector when used on O-2A FAC aircraft during daytime, visual reconnaissance missions. Specific objectives of the test were to:
>
> a. Modify four O-2A aircraft with INK system compatibility kits.
>
> b. Train three INK system maintenance personnel at operational site.
>
> c. Train six pilots as INK system operators at operational site.
>
> d. Refine combat tactics for INK system operational use.
>
> 3. Evaluate combat results obtained by use of INK systems.

By 13 February 1971, all of the four required O-2A aircraft had been modified to accept the INK equipment, 10 operators and two maintenance technicians were ready to begin training, and the evaluation was underway.[45] The following day the FACs flew the first sorties.

The necessary O-2A aircraft modification was relatively minor and the 20th TASS maintenance personnel performed it without difficulty. It consisted of:[46]

a. Connecting the power supply through a 7 or 10 amp circuit breaker to the aircraft 28 volt direct current (DC) with a cannon plug.

b. Replacing the aircraft door with a modified door which had a removable window and a suspension eyebolt on the upper window frame for the INK detector.

c. Modifying the right seat rail with a locking pin hole in the extreme aft position.

d. Removing the right rear seat from the aircraft.

As previously recommended by 7th Air Force, the 20th TASS was responsible for the INK equipment, which was under the operational control of the Military Region (MR) I Direct Air Support Center (DASC) for evaluation. The O-2As equipped for the INK program flew within RVN and eventually in Laos and Cambodia. This provided an excellent opportunity for testing the INK equipment against a wide variety of terrain, foliage, targets, and enemy defenses. The selection proved to be a good one as the INK gear remained with the 20th TASS during its entire stay in SEA.[47]

Tactical Air Command (TAC) and 7AF envisioned a 60-day test period with the equipment to remain in operational use by 7AF personnel if combat

results warranted.[48] Initially, the evaluation was to be restricted to missions within South Vietnam with later expansion into adjacent border areas if the devices proved successful and after appropriate combat tactics had been developed.[49]

Thus the INK systems were initially assigned in SEA to the "Speedy" Tactical Air Control Party (TACP) or I TACP and operated along the road networks within MR I. Specifically they were used over "those parts of the Ho Chi Minh Trail terminating within and near the A Shau Valley and points North and South of there within 10 nautical miles of the Laotian/Republic of Vietnam border."[50] (See Figure 5.)

Of the 10 operators initially selected for training, seven were FAC-qualified pilots and three were non-rated intelligence personnel. As it turned out, the three non-rated individuals were never placed on flying status, and two of the pilots were reassigned prior to the start of the training. However, the remaining pilots (plus two who were added later) were given three hours of ground training emphasizing familiarization with the equipment and best procedures for detecting targets. Following this, they began using the equipment in the air under the guidance of the introduction team. Project Officers considered the training complete when the operator began finding targets on a consistent basis.[51]

The two electronics maintenance technicians (AFSC 301XX) received 40 hours each of classroom instruction and training using one of the INK systems as a working model. A third man, an electronics maintenance specialist, learned through on-the-job training (OJT).[52]

Detection results were almost immediate. The first weekly "CORONET INK Status Report" submitted by I DASC covering the period 14 through 20 February 1971 contained the following statement: "Targets sighted this week: Eleven ten by twenty foot rectangular targets, one six by six foot square target, one three by eight foot rectangular target (he visually spotted supplies in the open after picking up the target), four small rectangular targets, three man targets moving on enemy road. All targets except three by eight supplies and men were invisible in direct three power viewing." This proved to be the tenor of all subsequent weekly reports--numerous targets detected, most of which were invisible without the aid of INK.[53]

As INK operators began using the equipment under actual combat conditions, they found that certain modifications of the tactics developed during the COMBAT INK OT&E were necessary. Whereas, in the Canal Zone, test personnel normally made more than one orbit and often spent 15 minutes on one area 500 feet in diameter, ground fire often made this impossible in SEA. Although the operators in Southeast Asia endeavored to do a complete 360 degree orbit about the target in order to get the best possible view of it, many times they had to do it in segments. One of the operators noted: "The minute that you flew a 15 to 20 degree arc in a 10 to 15 degree bank around the target and there was a gun down there, he would shoot at you. You were a sitting duck." Thus, they would fly approximately 10 seconds in an arc, break away, move back in on another section of the arc for 10 to 15 seconds, break away again possibly in the opposite direction, and so on until they had viewed the target from all sides.[54]

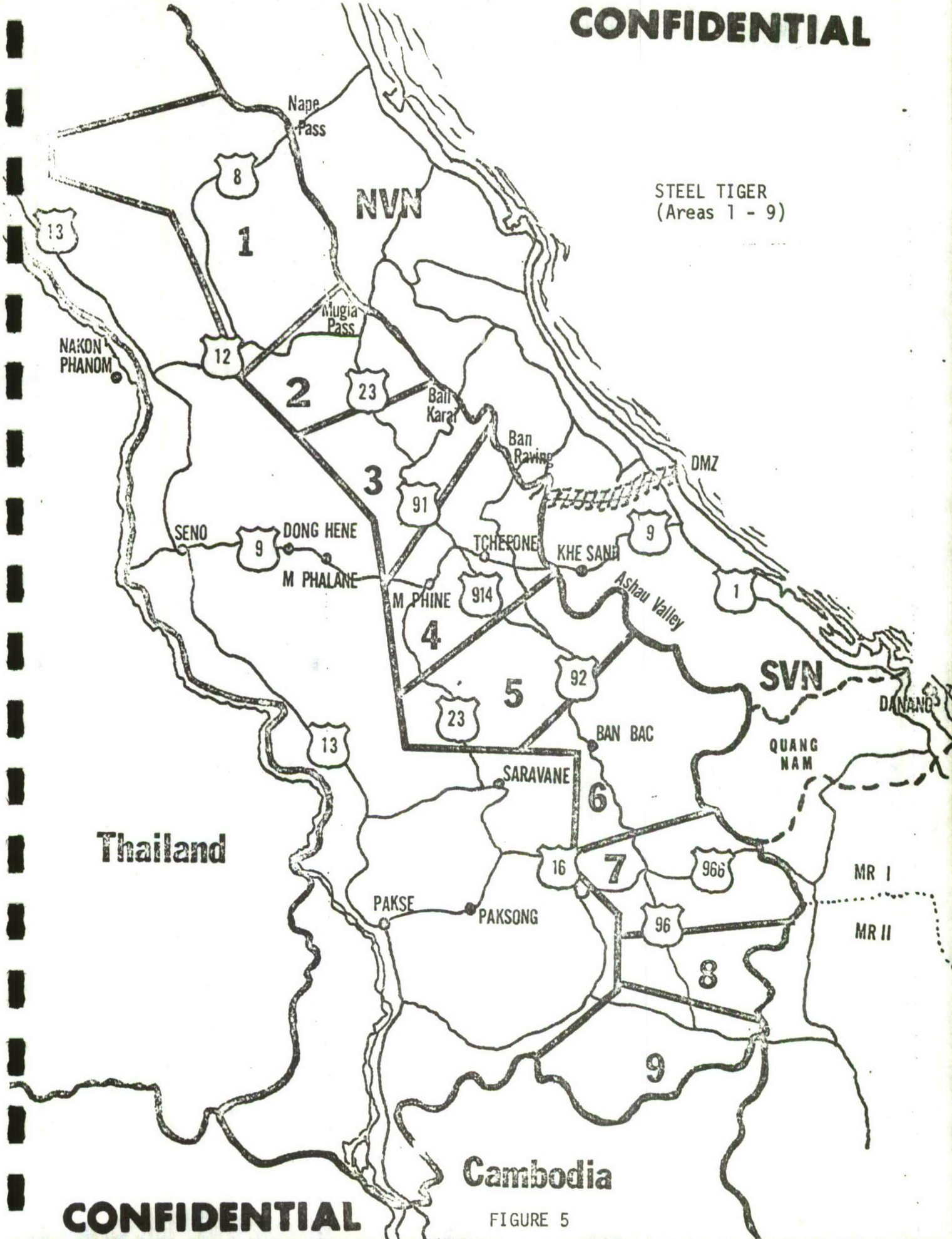

STEEL TIGER
(Areas 1 - 9)
Nape Pass
NVN
8
1
13
Mugia Pass
NAKON PHANOM
12
2
23
Ban Karai
Ban Raving
DMZ
3
91
SENO
9
DONG HENE
M PHALANE
TCHEPONE
KHE SANH
9
M PHINE
914
4
Ashau Valley
1
SVN
92
5
23
DANANG
BAN BAC
13
QUANG NAM
SARAVANE
6
Thailand
16
7
966
MR I
PAKSE
PAKSONG
96
MR II
8
9
Cambodia

FIGURE 5

At the time the INK equipment was introduced into SEA, Operation LAM SON 719 was well underway. This was a "South Vietnamese three-division-sized thrust into Laos along Route 9 between Khe Sanh and Tchepone conducted between 30 January and 24 March and supported by U.S. ground and air forces."[55] After a brief familiarization period and in response to a I DASC request, 7AF on 3 March 1971 authorized I DASC to begin INK operations in Laos.[56] At this point, the 20th TASS FACs pressed their INK support of the LAM SON 719 effort into Laos and continued through termination of the operation.[57] Results are shown in Table 1. (See Page 22.) During this period, the Air Force employed the INK detection equipment over road networks in Laos (especially along Route 9), along the Ho Chi Minh Trail, and as part of Operation LAM SON 719 but only within 20 nautical miles of the Demilitarized Zone.[58] (See Figure 5.) In the final analysis, little coverage of LAM SON 719 areas was possible due to "continuous close air support aircraft in 90 percent of the airspace. As the area shrank, it became impractical to work the INK system and its support of LAM SON 719 was curtailed on 20 Mar 71."[59]

On 1 April 1971, "Speedy" TACP was inactivated and the O-2A aircraft and four of the original pilots supporting the CORONET INK evaluation were transferred to the "Lopez" TACP where two other FACs joined them. In the new area of operation (AO), they were responsible for missions in the Quang Nam Sector of South Vietnam (see Figure 5) and in some of the special interdiction areas of MR I.[60] The area of operation included "an off-load point for enemy trucks, prior to moving supplies across the border [from Laos] into the Republic of Vietnam, and provided numerous targets

TABLE 1

CORONET INK SUPPORT

OF LAM SON 719

Sorties Flown	Targets Sighted	Results
	21 Feb - 2 Mar 71	
3	22 10' x 20'	3 were struck yielding 3 destroyed trucks. 10 were struck several times. Results unknown.
	1 10' x 20' (moving)	
	5 10' x 10' to 4' x 4'	
	3 Mar - 14 Mar 71	
6	6 10' x 20'	No air strikes were made on these targets due to higher priority targets (TIC, targets in the open) and weather.
	3 personnel	
	1 100mm gun	
	Numerous smaller targets	
	15 Mar - 23 Mar 71	
5	4 6' x 6' (suspected 37mm site)	No air strikes were made due to all fighters being used for close air support.
	4 10' diameter (in AA configuration)	

with minimum antiaircraft protection." Thus, it was an excellent area for testing the INK equipment.[61]

About the same time as the switch in TACPs, 7AF requested an extension of the CORONET INK program "to cover delays" in the evaluation of the program. On 7 April 1971, CSAF approved the request and extended the evaluation by 30 days to terminate 31 May 1971.[62]

During this period, strike support was assured with fighters assigned as a quick reaction force for Lopez INK sorties.[63] Also, beginning 9 April 1971, the 7th AF fragged two INK sorties per day to STEEL TIGER with priority air available through Hillsboro Airborne Battlefield Command and Control Center (ABCCC) in addition to the ground alert F-4s. Results were immediately apparent as evidenced by this excerpt from 20th TASS's 5 April through 11 April 1971 CORONET INK Status Report:[64]

* * * * * * *

> 7. Strike Results: INK ground alert F-4s were scrambled five times against INK targets resulting in one truck destroyed, one raft destroyed, 3150 cu ft [of] supplies destroyed, two enemy personnel KBA [killed by air], seven secondary explosions, and ten sustained fires. Two other flights provided from Hillsboro ABCCC for INK targets resulted in one 37mm gun destroyed, one secondary explosion at gun position with black smoke to 500 feet, one elephant [towing supplies] KBA, and one sustained fire. . . .
>
> * * * * * * *
>
> 10. During this period, eighty one INK targets were sighted and are now considered too numerous to report by size. All targets worth hitting were attacked.

Some interest had been expressed earlier by the Hq PACAF Director of Operations concerning a possible OV-10 PAVE NAIL (laser designator) application for the INK equipment during the upcoming Commando Hunt VII.[65] Therefore, while operating with the PAVEWAY F-4s, INK system operators attempted to detect the PAVEWAY laser beam. Although detection was not possible due to the short pulse width of the laser, they found that CORONET INK and PAVEWAY made an excellent team. INK found the target; PAVEWAY destroyed it.[66]

Seventh Air Force, feeling increased emphasis and more testing in Laos and Cambodia were necessary in order to complete the evaluation by the end of May 1971, encouraged 20th TASS to transfer the INK operation to the Covey TACP at Da Nang, whose mission was in Laos. The 20th TASS transferred the INK aircraft and the four original operators to Covey on 12 April 1971. They established an INK flight, added two more pilots, and began fragging the flight for two sorties per day in southern Laos, staying clear of designated high threat areas as 7AF instructed.[67] On 19 April 1971, however, INK operations expanded into VR sectors 12 and 13 of STEEL TIGER, roughly equivalent to new VR sectors six and seven (see Figure 5), to reach numerous lucrative targets. A day later 7AF removed the "high threat" restriction giving them complete freedom of movement in these sectors thereby significantly enhancing realistic combat evaluation. They also maintained close surveillance of the Ho Chi Minh Trail along Routes 91 and 914.[68]

Following the switch of the INK operation to Covey TACP, the INK operators had to familiarize themselves with the new area of operation. Also, F-4 ground alert support had ceased on 17 April 1971 and renewal was not requested because support through Hillsboro was considered sufficient. However, during the following month, fighter support was often either non-existent or too late to be of any value. The result of the above combination of factors was a substantial reduction in the overall INK performance from mid-April to mid-May 1971.[69]

Then, on 13 May 1971, INK operators began using the systems in support of a search and rescue (SAR) effort. The search was for a single individual whose only means of communication was a visual escape and evasion (E&E) code letter. Since the E&E letter was not necessarily an INK detectable target, the INK gear was not used exclusively. However, INK FACs, flying four sorties per day for a little over two weeks (a total of 66), assisted in the search of all suspect areas and sighted many enemy personnel although they were not attempting to locate enemy targets for destruction. This provided an excellent opportunity for evaluating the INK equipment in a SAR role, and the introduction team felt the system performed well in this capacity. The system had no capability for differentiating between enemy and friendly man-sized returns, however, and identification could be judged only on the basis of whether the man cooperated by remaining in view or signaling. Therefore, team members concluded that the system's identification capability could be significantly improved by incorporating stabilized binoculars. The SAR effort proved unsuccessful and terminated on 29 May 1971 as did the entire CORONA INK evaluation.[70]

During the course of the CORONET INK evaluation in SEA, FACs using the INK systems detected 611 targets which were undetectable by other means. They varied in size from man-size to 20 meters by 60 meters. Most of the targets were three meters by three meters (probable supply stacks) or three meters by seven meters (probable vehicles). Fighters attacked 217 of the targets but had not attacked the remaining 394 because they were too small to be worthwhile, adverse weather prevented attack, or fighters were not available. However, the strikes had achieved the following results:[71]

Target	Results
37mm guns	five destroyed
Trucks	11 destroyed
Trucks or vehicles	eight damaged
Supplies	5,750 cubic feet destroyed
Bunkers	two destroyed
Camouflaged road cover	250 meters destroyed
Elephant (towing supplies)	one killed by air
*Enemy personnel	13 killed by air
Raft	one destroyed
Secondary explosions	40
Sustained fires	38

From a maintenance perspective, the five systems had operated 280 hours in the air (194 sorties) and 68 hours on the ground for a total of 348 hours during the three and one-half month evaluation. During this period, the equipment malfunctioned 45 times for a resultant 7.7 hours mean time between failures. Four of the systems were always in commission and all five were in commission 90 percent of the time with only about a 10 percent depletion of the 90-day parts kit. In addition, 20th TASS maintenance

*Approximately 400 enemy personnel were detected with the INK equipment during CORONET INK evaluation. The largest group sighted consisted of 30 personnel; however, most were either single or in groups of two.

personnel in conjunction with introduction team members made the following modifications to the INK systems during the test:[72]

a. Designed, built, and installed new suspension hooks for all of the detector heads.

b. Installed a mike button in the right handle on all detector heads.

c. Replaced three-power solenoid switches with sealed switches as failures occurred.

d. Added capacitors to detector printed circuit boards to obtain correct pulsing of trigger for square wave modulation of tubes in both phases.

As noted earlier in the report, tactics were modified upon arrival in SEA. The aircraft flew a right hand orbit and allowed the INK system to view the target at about a 45-degree angle. Thus the radius of the orbit was always approximately equal to the aircraft's height above the target. Where there was only a small arms or .50 caliber threat, the INK FAC maintained 3,200 feet altitude AGL. In areas where 23mm, 37mm, and 57mm guns were present, he flew at altitudes of 8,500 feet or higher.[73] No INK aircraft were damaged by ground fire during the test.

Training INK operators had been a major problem during the CORONET INK evaluation. At the conclusion of the test, two operators were qualified and four others were in various stages of training. The slow progress in this area was the result of several factors: (1) tactical mission requirements often took priority; (2) each time the INK flight was switched to a new TACP, some INK instruction time was lost while the pilots became familiar with the new AO; (3) since the training was conducted in actual combat areas, controlled targets could not be used; (4) the enemy used

mostly natural camouflage (foliage) and most targets detected resulted from enemy movements or poor camouflage; and (5) since the INK equipment provided no method for identifying the type of target detected or of easily eliminating natural targets, operators had to resort to the cumbersome procedure of using auxiliary binoculars which proved extremely difficult for trainees.[74]

When the introduction team chief debriefed the operators at the termination of the test, "Operators with over 25 hours on the INK system felt that they could find targets. All operators felt that the INK system was difficult to use. All qualified operators wanted to keep the INK system with the 20th TASS after the evaluation was complete."[75]

At the conclusion of the test, the introduction team chief and USAFTAWC recommended that the five INK systems remain with the 20th TASS, and 7AF concurred. However, 7AF stated that they had no requirement for any additional INK system procurement in view of the SEA phasedown and the adequacy of system quantities already in SEA. The INK program remained in operational use by the 20th TASS for another year.[76]

Coincident with the termination of the CORONET INK test phase on 29 May 1971, the INK flight began operating throughout VR sectors four through nine in STEEL TIGER. (See Figure 5.) Except for an occasional mission in MR I in RVN, they operated mostly in the STEEL TIGER area for the remainder of their time in SEA.[77]

INK missions into STEEL TIGER out of Da Nang AB taxed the weight and endurance capability of the O-2A. With the added weight of the second

pilot (INK operator), the INK equipment, and sufficient fuel for the mission, the aircraft routinely took off from Da Nang AB with the maximum weight possible. Enroute time to and from the AO averaged about one hour in each direction. This coupled with an average two and one-half to three hours station time totaled about four and one-half to five hours per mission or near maximum endurance under those operational conditions. In fact, some station times had to be reduced by 15 to 25 minutes because of the additional weight. In short, the O-2A was not designed to carry the weight which the INK missions over STEEL TIGER demanded of it.[78]

Another problem imposed on the O-2A by operations in some parts of STEEL TIGER was that of altitude limitations. The terrain was high, often rising to 5,000 feet or more. Since the O-2A carried no supplemental oxygen, the crews could not exceed 10,000 feet. This placed them well within range of any of the larger guns in the area although they were only occasionally fired upon and none were ever hit. The guns, however, did force them to fly well above INK's most effective altitude of 3,200 feet AGL.[79]

During actual combat employment, the INK equipment performed best when used in a supplementary role and when teamed with the 20 power stabilized binoculars. On a standard mission, the INK operator would check with the ABCCC when arriving on station, ascertain if any of the controlling FACs in the area had any targets which they wanted "INKed," and if not would either proceed to check out targets provided by intelligence or search for targets of opportunity. When looking for targets of opportunity, the normal practice was to take the detector head out of the

window and go straight VR using the hand held, 10 power binoculars. If the operator located a likely target, he would put the detector head back in the window and, using the three power lens to orient himself, would check it out with the INK system. If INK returns appeared, he would then use the 20 power stabilized binoculars for a closer view to eliminate natural targets. After verifying the target and determining whether it appeared lucrative enough to merit a strike, he would locate it for the controlling FAC in the area who would then direct the strike. Or, if the other FAC was busy, he could put the strike in himself. Some of the INK operators felt that having to "hand off" their targets to another FAC was cumbersome and that it would have been much better for them to put in all of the strikes against their own targets whenever possible.[80]

During November 1971, INK FACs began flying in support of Project Island Tree which was an effort by Task Force Alpha (TFA) to target large concentrations of NVA troops in supply areas and rest stops along the Ho Chi Minh Trail in STEEL TIGER. Once TFA established the acoustically targeted areas (ATAs) using multi-source intelligence (including INK VR), ARC LIGHT missions were scheduled against them while TFA used pre-dropped acoustical sensors to aid in bomb damage assessment. The project, including INK support, continued throughout the dry season in STEEL TIGER, ending about March 1972.[81]

On 23 November 1971, Aerospace Systems Division advised 7AF and 20th TASS that ASD was investigating an improved target marking capability for designating camouflaged targets found by the INK device. The item under

consideration was a light weight laser illuminator developed by International Laser System. It had dimensions of four and one-half by five by 14 inches, weighed about eight pounds, and was compatible with laser seekers aboard fighter aircraft. As envisioned, it would have either been hand held or mounted on the INK device with the beam folded through the optics and out through the stabilized dynalens subsystem. However, on 10 December 1971, ASD shelved the idea indefinitely when it appeared several of the operational INK units would be required for installation in Credible Chase aircraft, leaving none available for testing.[82]

During December 1971, the Air Staff considered including one or more of the INK systems in the CREDIBLE CHASE combat evaluation. However, shortly thereafter, they terminated the proposed inclusion of INK without providing rationale.[83]

As noted earlier in this report, maintenance personnel supported a 90 percent in-commission rate for the five INK systems during CORONET INK with only about a 10 percent depletion of the spare parts.[84] Then on 1 October 1971, 20th TASS advised 7AF that the dynalenses in all five detector heads were leaking oil. While they could be refilled, realignment was required with each oil service, necessitating six hours maintenance time per set. They also reported that both spare dynalenses were clouded on the inside and therefore unusable. The dynalens was a vital part of the system and could only be repaired or replaced on an individual basis in the United States.[85]

About the same time, the spare parts kit was beginning to dwindle. This in conjunction with the dynalens problem marked the beginning of a continuing struggle for maintenance, parts, and funds which continued through the end of INK's SEA employment.[86]

By the Spring of 1972, although the INK systems were often used for up to four missions per day giving sunrise to sunset VR coverage, they were breaking down more often and becoming increasingly difficult to maintain. Two of the five systems were almost constantly in a not operationally ready, due to lack of supplies (NORS) condition. Supply was a major problem as parts had to be individually ordered and produced and, therefore, were expensive. Also, since the parts were produced on an "as needed" basis, considerable time elapsed before the replacement parts were received by 20th TASS. Thus 20th TASS maintenance personnel were frequently forced to resort to cannibalization in order to keep at least three of the systems operational.[87]

On 31 March 1972, PACAF provided funds to cover spare parts procurement through the end of the dry season and advised 7AF that the INK operation faced three alternatives:

a. Terminate INK operations upon depletion of the spares inventory.

b. Establish a requirement for additional production systems to include entry into the USAF logistics system.

c. Continue operations and support of the five existing devices for an additional year.

PACAF asked that 7AF evaluate their future requirement for INK systems and comment on the desired alternative.[88] Seventh Air Force responded by saying that the INK program in SEA would be terminated not later than 30 June 1972 and requested shipping instructions for the INK equipment.[89] Actual INK operations in SEA ceased about 7 April 1972 with the start of the North Vietnamese (NVN) Spring Offensive, and the aircraft and crews which had been used in support of the INK program were assigned to fly regular FAC missions.[90]

Although apparently no one item sounded the death knell for INK's operational employment, several factors seem to have contributed to its early demise. They were as follows:

a. Since the INK devices were prototype units and were never entered into the Air Force logistics system, replacement parts had to be requisitioned and produced on an "as required" basis. Therefore, parts and stateside maintenance were quite expensive and often very slow in responding to operational requirements.

b. The problem with supplies and spare parts was compounded by the fact that the company which engineered and manufactured the major subassemblies of the system went out of business shortly after they delivered the last INK system to USAFSOF.

c. There was no "pool" of trained personnel. All personnel had been trained in the field by the introduction team, and no provision was made for continental United States (CONUS) training of operators or maintenance personnel.[91]

d. Seventh Air Force had determined that there was no USAF requirement for any more of the systems in SEA nor was there any Vietnamese Air Force (VNAF) requirement for them.[92]

e. Twentieth TASS urgently needed the aircraft and crews which had supported the INK operation for normal FAC missions in countering the NVN Spring Offensive.

f. With the start of the Spring Offensive, targets were so plentiful that the INK equipment was not really necessary. The problem was no longer one of finding targets but rather one of destroying them.[93]

On 30 May 1972, ASD asked 7AF to ship all of the INK equipment to them when its operational employment was terminated. The 366 TFW (host base) at Da Nang AB forwarded the equipment to ASD at Wright Patterson AFB, Ohio, on 24 June 1972 officially and finally terminating its presence in Southeast Asia.[94]

CHAPTER IV

SUMMARY

With the benefit of a retrospective view of the entire INK program including HAVE INK, HAVE INK II, COMBAT INK, CORONET INK, and the follow-on combat employment, individuals and units involved with the program drew certain conclusions and made certain recommendations.

The O-2A modification was acceptable as configured and required no maintenance. With the required kits available, modifications can be accomplished in the field in less than two hours per aircraft.

If necessary, maintenance training can be conducted in the field; however, large groups could be more effectively trained in the CONUS by Air Training Command. Air Force maintenance personnel can fully maintain the INK system if they have the required parts available.

Whenever possible, operator training should not be conducted in a combat zone. Lack of controlled targets in jungle terrain severely limited and slowed operator training. Also, all operators were pilots; this created a morale problem for young pilots who wanted to devote 100 percent of their flying time to pilot duties.

Combat tactics as employed in SEA were successful. The INK crews were exposed to no unnecessary risks, and the results they obtained were good.

Combat results definitely indicate that the INK device was a valuable asset to the FAC and was most effectively used as a complement to other FAC equipment in detecting enemy targets.

The INK system had two main deficiencies which require correction: First, the unstabilized three-power locating subsystem was difficult to use in pinpointing targets previously detected. It was too weak and too unstable. Second, the system included no means for identifying targets. It was impossible in most cases to determine what the targets were until after they had been attacked and exposed from their camouflaged positions. Thus FACs had to use hand-held binoculars above 3,000 feet AGL in order to eliminate natural targets. A modification to include an identification feature could vastly improve the equipment's operational effectiveness and capability.

Many targets detected by use of the INK system could not be visually acquired by strike aircraft called in by the FACs. Therefore, a laser designator or other similar device could provide an acceptable marking system for directing attacking aircraft.[95]

The INK system appeared to have distinct possibilities for use in a SAR role, either military or civilian. This would be especially true if "cooperating materials" could be perfected and used to identify the object of the search.[96]

Recommendations for solving some of the problems raised during the INK operational employment may be found in the Appendix.

Thus the INK system was conceived, developed, employed in a combat environment, and finally shelved indefinitely. Only time, future requirements perhaps in other theaters, available funds, competing technology, and other such considerations will determine whether it is ever reintroduced.

APPENDIX

FIELD RECOMMENDATIONS ON INK PROGRAM

The three power locating subsystem should be deleted and a tube and filter bypass added to provide direct viewing through the stabilizer. Also the seven and fifteen power lenses should be replaced with a seven to fifteen or seven to twenty powered zoom lens to assist the operator in locating targets. In operation, this would allow a change of scene to real life for identification after an INK target is sighted and then a zoom back to lower power to locate it.[97]

Other recommended modifications to the detector head were as follows. First, since there were too many controls on the right side of the head to be operated with the right hand, the mike button should be moved to the left side. Second, the case material became soft and deformed when exposed to sunlight and heat for prolonged periods on the ground and should be replaced. Third, an effort should be made to reduce the weight of the head to the point where it could be hand-held thereby allowing increased mobility and less vibration. Fourth, the automatic iris feature should be replaced with a manual control. Fifth, since the binocular eyepiece required expensive and critical assembly and alignment, it should be redesigned. Sixth, the objective lens should be focusable so that image-tube replacement is less critical. The photo cathode position was critical to within 0.010 inch because of the fixed-focus objective design.[98]

If the system is ever rejuvenated and future requirements established, consideration should be given to adapting the equipment to a turret mount

with a co-aligned laser marking system. One possibility would be to incorporate it in the PAVE NAIL pod on the OV-10.[99]

Operators should be trained before operating in a combat environment. They should also be persons (either officers or enlisted) who are dedicated to operating the INK equipment as opposed to pilots who had to perform their primary flying duties at least 50 percent of the time.[100]

In order to give the INK system a larger operating area and to overcome the deficiencies of the O-2A mentioned earlier, the equipment should be installed in a more powerful aircraft. Although the OV-10 was previously ruled out because of interference with the ejection seat, it or a similar aircraft should be considered for future INK operations.[101]

FOOTNOTES

1. Msg (S), DCS/Plans, Hq 7AF to CINCPACAF, 220200Z Aug 71.

2. Talking paper (S), 20 TASS, Subj: 20 TASS FAC Operations in MR I, 17 Jul 71, Project CHECO microfilm roll (CMR) Secret #525, 004.

3. Briefing (C), USAFSOF, Subj: CORONET INK Ingress, 8 Feb 71 [hereinafter cited as CORONET INK Ingress Briefing]; Technical Report No. AFWL-TR-70-62 (C), Advanced Direct-Viewing Camouflage Detector (COMBAT INK), Oct 1970 [hereinafter cited as AFWL-TR-70-62], p. ii.

4. CORONET INK Ingress Briefing (C); TAC OPLAN 19, Subj: CORONET INK Deployment and Evaluation Plan (C), 8 Sep 70, p. 1 [hereinafter cited as TAC OPLAN 19]; Final Report (S), CORONET INK (COMBAT INK Combat Evaluation), USAFTAWC, Sep 1971 [hereinafter cited as CORONET INK Final Report], p. 1.

5. AFWL-TR-70-62 (C), p. 3; CORONET INK Final Report (S), p. 1.

6. AFWL-TR-70-62 (C), p. 14.

7. Ibid.

8. CORONET INK Final Report (S), p. 1.

9. AFWL-TR-70-62 (C), p. 10.

10. CORONET INK Final Report (S), p. 1.

11. AFWL-TR-70-62 (C), p. 3.

12. CORONET INK Final Report (S), p. 1.

13. Ibid.

14. Final Report (C), COMBAT INK, USAFTAWC, Aug 1971 [hereinafter cited as COMBAT INK Final Report], p. 1; AFWL-TR-70-62 (C), p. 5.

15. AFWL-TR-70-62 (C), p. 1.

16. COMBAT INK Final Report (C), p. 1.

17. CORONET INK Final Report (S), p. 2.

18. AFWL-TR-70-62 (C), p. 5; CORONET INK Ingress Briefing (C); COMBAT INK Final Report (C), p. 1.

19. AFWL-TR-70-62 (C), p. 5.

20. Ibid., pp. iii, 5.

21. Ibid., p. 41.

22. Ibid.; COMBAT INK Final Report (C), p. 2.

23. COMBAT INK Final Report (C), p. 2.

24. Ibid., p. 31; Ltr (C), USAFSOF to CINCPACAF, Subj: Slides of INK System and Typical Targets, 23 Sep 70.

25. COMBAT INK Final Report (C), pp. 5, 19.

26. Ibid., p. 4; Ltr (C), USAFSOF to CINCPACAF, Subj: Slides of INK System and Typical Targets, 23 Sep 70.

27. COMBAT INK Final Report (C), pp. 4, 5; CORONET INK Final Report (S), p. 17; Armament Development and Test Center, "COMBAT INK," a special film (C) produced to document portions of the results of TAC Test 69-226 (SOF Test 2V-64) [hereinafter cited as COMBAT INK Film].

28. COMBAT INK Final Report (C), p. 5; CORONET INK Final Report (S), p. 17; Msg (S), 20 TASS to 7AF, 260730Z Aug 71, CMR S-525, 050; Msg (S), 20 TASS to 7AF, 031210Z Sep 71, CMR S-525, 042; Msg (S), 20 TASS to 7AF, 170515Z Sep 71, CMR S-525, 042; COMBAT INK Film (C).

29. COMBAT INK Final Report (C), pp. 5, 6. CORONET INK Ingress Briefing (C), p. 2.

30. CORONET INK Ingress Briefing (C), p. 4.

31. Msg (C), DCS/Rqmts, Hq TAC to CSAF, 221336Z Jan 71; TAC OPLAN 19 (C), pp. 0-1.

32. COMBAT INK Final Report (C), p. 7.

33. AFWL-TR-70-62 (C), p. 41.

34. CORONET INK Ingress Briefing (C), p. 2.; Msg (C) DCS/Rqmts, Hq TAC to CSAF, 221336Z Jan 71; Msg (C) DCS/Rqmts, Hq TAC to CINCPACAF, 301600Z Jun 70.

35. COMBAT INK Final Report (C), pp. 7, V; Msg (C), DCS/Rqmts, Hq TAC to CINCPACAF, 131935Z Aug 70.

36. COMBAT INK Final Report (C), p. 39; Msg (C), DCS/Rqmts, Hq TAC to CSAF, 221336Z Jan 71.

37. COMBAT INK Final Report (C), p. 7; CORONET INK Final Report (S), p. 2.

38. COMBAT INK Final Report (C), p. 9; COMBAT INK Film (C).

39. Ibid.

40. Ibid., p. 8.

41. CORONET INK Final Report (S), p. iii.

42. CORONET INK Ingress Briefing (C), p. 6.

43. Msg (C), 20 TASS to USAFSOF, 110540Z Feb 71; CORONET INK Ingress Briefing (C), pp. 5, 6.

44. CORONET INK Final Report (S), p. 2.

45. Ibid.; Msg (S), I DASC to CSAF, 151021Z Feb 71.

46. CORONET INK Final Report (S), pp. 3, 25.

47. Intvw (S), author with Capt Ronald R. Jones, 20 TASS, 16 Jan 73 [hereinafter cited as Jones Intvw]; Ltr (S), 20 TASS to 504 TASG, Subj: 20th TASS Primary Mission Requirements and Capabilities, 2 Sep 71, CMR S-525, 006.

48. CORONET INK Ingress Briefing (C), p. 6; TAC OPLAN 19 (C), p. 4.

49. Msg (C), DCS/Plans, 7AF to CINCPACAF, 220201Z Jun 70.

50. CORONET INK Final Report (S), p. 31.

51. Ibid., pp. 3, 4, 45.

52. Ibid., pp. 3, 4, 43; TAC OPLAN 19 (C), p. 1.

53. Msg (S), I DASC to CSAF, 230210Z Feb 71.

54. COMBAT INK Final Report (C), p. 5; Jones Intvw (S).

55. Project CHECO Southeast Asia Report (S), Lam Son 719 30 Jan-24 Mar 1971 the South Vietnamese Incursion into Laos, 24 Mar 71, p. 1.

56. Msg (S), DCS/Ops, 7AF to 504 TASG, I DASC, 031200Z Mar 71.

57. Msg (S), I DASC to CSAF, 100300Z Mar 71; Msg (S), I DASC to CSAF, 161030Z Mar 71; Msg (S), I DASC to CSAF, 290225Z Mar 71.

58. CORONET INK Final Report (S), p. 31.

59. Msg (S), I DASC to CSAF, 290225Z Mar 71.

60. Staff Summary Sheet (S), 7AF, Dir/Comd and Con to DCS/Ops, Subj: CORONET INK System, 27 Mar 71, CMR S-557, 218; Msg (S), I DASC to CSAF, 290225Z Mar 71.

61. CORONET INK Final Report (S), p. 4.

62. Msg (S), I DASC to CSAF, 290225Z Mar 71; Msg (U), C/S, 7AF to COMUSMACV, 010401Z Apr 71; Msg (C), DCS/Plans, CSAF to TAC, 071559Z Apr 71; Memo (S), DCS/Ops to CINCPACAF, Subj: CORONET INK Evaluation, 31 Apr 71; Fact Sheet (S), Hq PACAF, Subj: CORONET INK, 1 May 1971.

63. Msg (S), I DASC to CSAF, 060716Z Apr 71.

64. Msg (S), 20 TASS to CSAF, 120850Z Apr 71.

65. Msg (S), DCS/Ops, PACAF to 7AF, 020222Z Apr 71.

66. Msg (S), 20 TASS to CSAF, 120850Z Apr 71.

67. Msg (S), DCS/Ops, 7AF to 504 TASG, 20 TASS, 100315Z Apr 71; Msg (S), I DASC to CSAF, 290225Z Mar 71; Msg (S), 20 TASS to CSAF, 120850Z Apr 71; CORONET INK Final Report (S), p. 4; Msg (S), 20 TASS to 7AF, 150500Z Apr 71, CMR S-525, 035.

68. Msg (S), 20 TASS to CSAF, 190245Z Apr 71; Msg (S), DCS/Ops, 7AF to 504 TASG, 20 TASS, 200204Z Apr 71, CMR S-557, 216; CORONET INK Final Report (S), p. 31.

69. Msg (S), 20 TASS to CSAF, 190245Z Apr 71; Msg (S), 20 TASS to CSAF, 252353Z Apr 71; Msg (S), 20 TASS to CSAF, 030850Z May 71; Msg (S), 20 TASS to CSAF, 100755Z May 71; Msg (S), 20 TASS to CSAF, 180145Z May 71.

70. Msg (S), 20 TASS to CSAF, 180145Z May 71; Msg (S), 20 TASS to CSAF, 240155Z May 71; Msg (S), 20 TASS to CSAF, 010813Z Jun 71; CORONET INK Final Report (S), p. 6; Briefing (S), USAFTAWC, Subj: CORONET INK Briefing, 3 Jun 71, p. 6 [hereinafter cited as CORONET INK Egress Briefing].

71. CORONET INK Final Report (S), pp. 5, 6, 48.

72. Ibid., pp. 39, 4; Ltr (C), USAFTAWC to TAC, Subj: CORONET INK Parts Support, 19 Oct 71.

73. CORONET INK Final Report (S), p. 5.

74. Ibid., pp. 4, 5; CORONET INK Egress Briefing (S), p. 2.

75. CORONET INK Final Report (S), p. 5.

76. Ltr (C), USAFTAWC to TAC, Subj: CORONET INK Parts Support, 19 Oct 71; CORONET INK Final Report (S), p. 16; Msg (S), DCS/Plans, 7AF to CINCPACAF, 230201Z Aug 71.

77. Staff Summary Sheet (S), 7AF, Dir/Comd and Con to Comdr, Subj: CORONET INK/Island Tree Operation, 11 Nov 71, CMR S-557, 220.

78. Jones Intvw (S); Msg (S), 20 TASS to 504 TASG, Sep 71, CMR S-525, 002.

79. Jones Intvw (S); COMBAT INK Final Report (C), p. 7.

80. Jones Intvw (S); Intvw (S), author with 1Lt Joseph M. Jewel, 71 ARS (formerly assigned to 20 TASS), 5 Apr 73 [hereinafter cited as Jewel Intvw].

81. Staff Summary Sheet (S), 7AF, Dir/Comd and Con to DCS/Ops, Subj: CORONET INK/Island Tree Operation, 11 Nov 71, CMR S-557, 220; Intvw (S), author with 1Lt Curtis E. Perkins, 346 Bombardment Sqn (formerly assigned to 20 TASS), 28 Mar 73 [hereinafter cited as Perkins Intvw]; Intvw (S), author with Capt Robert K. Tiernan, 13th ADVON/Intel (formerly assigned to TFA), 7 Jun 73.

82. Msg (C), ASD to TAC et al, 231923Z Nov 71; Msg (C), ASD, to 7AF, 102120Z Dec 71.

83. Msg (S), Dir/Rqmts, PACAF to 7AF, 300201Z Nov 71; Msg (S), DCS/Plans, CSAF to CINCPACAF, 092023Z Dec 71; Memo (S), Dir/Rqmts to DCS/Ops, PACAF, Subj: COMBAT INK Camouflage Detectors, 16 Mar 72.

84. CORONET INK Final Report (S), p. 4; Ltr (C), USAFTAWC to TAC, Subj: CORONET INK Parts Support, 19 Oct 71.

85. Msg (S), 20 TASS to 7AF, 010750Z Oct 71, CMR S-525, 044; Ltr (C), USAFTAWC to TAC, Subj: CORONET INK Parts Support, 19 Oct 71.

86. Ltr (C), USAFTAWC to TAC, Subj: CORONET INK Parts Support, 19 Oct 71; Msg (C), DCS/Log, 7AF to 20 TASS, 040946Z Nov 71; Msg (C), ASD to TAC, 231923Z Nov 71; Msg (S), DCS/Log, 7AF to ASD, 300200Z Dec 71; Msg (C), Dir/Rqmts, PACAF to AFSC, 082321Z Mar 72; Msg (S), DCS/Ops, PACAF to CSAF, 160502Z Mar 72; Msg (C), Dir/Rqmts, PACAF to ASD, 310144Z Mar 72; Jones Intvw (S); Perkins Intvw (S).

87. Jones Intvw (S); Perkins Intvw (S).

88. Msg (C), Dir/Rqmts, PACAF to ASD, 310144Z Mar 72.

89. Msg (C), DCS/Ops, 7AF to PACAF, 280115Z Apr 72.

90. Perkins Intvw (S); Jones Intvw (S).

91. Memo (S), Dir/Rqmts to DCS/Ops, PACAF, Subj: COMBAT INK Camouflage Detectors, 16 Mar 72; Memo (S), Dir/Rqmts to DCS/Ops, PACAF, Subj: COMBAT INK for Search and Rescue, 6 Jun 72; Msg (S), DCS/Ops, PACAF to CINCPAC, 100337Z Jun 72.

92. Msg (S), DCS/Plans, 7AF to CINCPACAF, 230201Z Aug 71; Msg (S), DCS/Ops, 7AF to CINCPACAF, 110600Z Mar 72; Msg (S), DCS/Ops, PACAF to CSAF, 160502Z Mar 72.

93. Perkins Intvw (S); Jones Intvw (S); Jewel Intvw (S).

94. Msg (U), ASD to 7AF, 301845Z May 72; Msg (U), 366 TFW to ASD, 270415Z Jun 72.

95. CORONET INK Final Report (S), pp. 3, 16; CORONET INK Egress Briefing (S), pp. 9, 10; Jewel Intvw (S); Jones Intvw (S).

96. Perkins Intvw (S); AFWL-TR-70-62 (C), p. 46.

97. CORONET INK Final Report (S), p. 16; Jones Intvw (S); CORONET INK Egress Briefing (S), p. 11.

98. CORONET INK Egress Briefing (S), p. 7; Jones Intvw (S); AFWL-TR-70-62 (C), p. 45.

99. CORONET INK Final Report (S), p. 16.

100. CORONET INK Egress Briefing (S), p. 11; Perkins Intvw (S).

101. Jones Intvw (S).

GLOSSARY

AA	Antiaircraft
AAA	Antiaircraft Artillery
AB	Air Base
ABCCC	Airborne Battlefield Command and Control Center
AF	Air Force
AFB	Air Force Base
AFSC	Air Force Systems Command
AFWL	Air Force Weapons Laboratory
AGL	Above Ground Level
AO	Area of Operation
ASD	Aerospace Systems Division
ATA	Acoustically Targeted Area
BDA	Bomb Damage Assessment
CD	Camouflage Detection
CMR	CHECO Microfilm Roll
CONUS	Continental United States
CREDIBLE CHASE	(S) A light, short takeoff and landing transport/mini-gunship concept.
CSAF	Chief of Staff, Air Force
DASC	Direct Air Support Center
DC	Direct Current
E&E	Escape and Evasion
FAC	Forward Air Controller
GP	General Purpose
IR	Infrared
KBA	Killed by Air
mm	Millimeter
MR	Military Region
NORS	Not Operationally Ready, Supply
NVA	North Vietnamese Army
NVN	North Vietnamese
OJT	On-the-Job Training
OT&E	Operational Test and Evaluation

QRF	Quick Reaction Force
RADC	Rome Air Development Center
RVN	Republic of Vietnam
SAR	Search and Rescue
SEA	Southeast Asia
TAC	Tactical Air Command
TACP	Tactical Air Control Party
TASS	Tactical Air Support Squadron
TFA	Task Force Alpha
TFW	Tactical Fighter Wing
TIC	Troops in Contact
U.S.	United States
USAF	United States Air Force
USAFSOF	United States Air Force Special Operations Force
USAFTAWC	United States Air Force Tactical Air Warfare Center
VC	Viet Cong
VNAF	Vietnamese Air Force
VR	Visual Reconnaissance